The power of GEDI: Investigate the efficacy of spaceborne Lidar to model biodiversity and characterize habitat heterogeneity at the continental and global scales

Qiongyu Huang
Smithsonian Conservation Biology Institute
HuangQ@si.edu

Smithsonian

NASA

GEDI ECOSYSTEM LIDAR

Funded by NASA Earth Science Division New (Early Career) Investigator Program (NIP)
80NSSC21K0936

Team Members

Post-Doctoral Fellow
Dr. Jin Xu
Smithsonian Conservation Biology Institute

Collaborator
Dr. Volker Radeloff
University of Wisconsin Madison

Collaborator
Dr. Melissa Songer
Smithsonian Conservation Biology Institute

Smithsonian

NASA

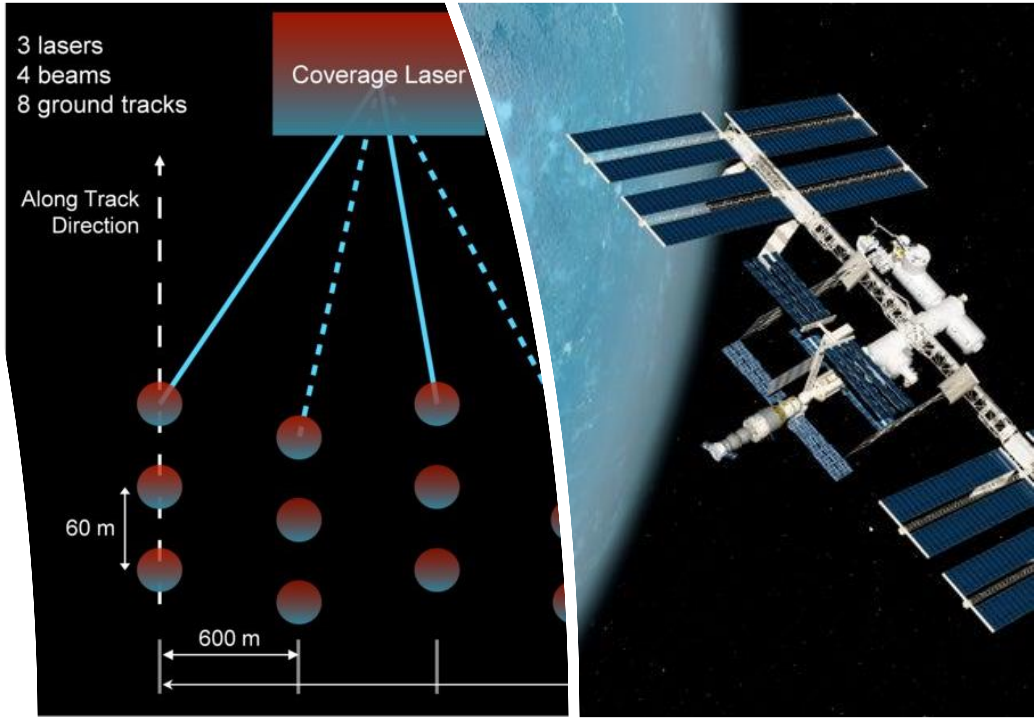
GEDI
ECOSYSTEM LIDAR

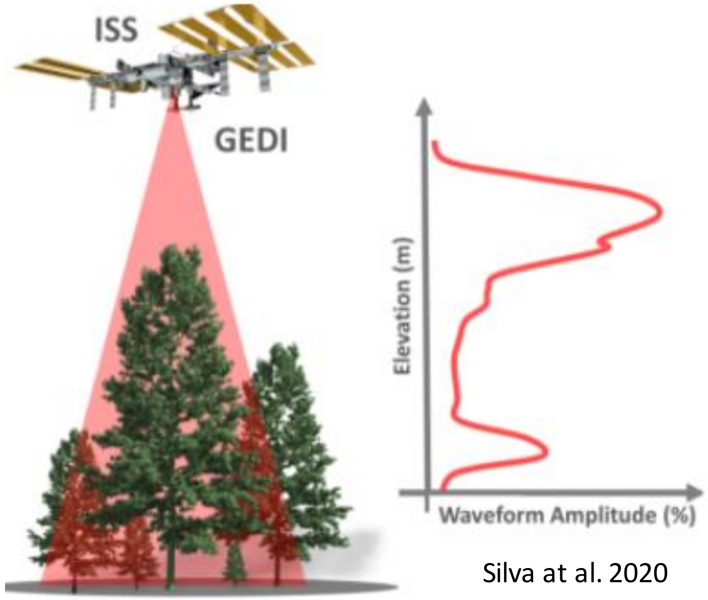
Background

- Vegetation's three-dimensional (3-D) structure is a key predictor of biodiversity.
- Vegetation vertical structure, often difficult to observe by optical remote sensing instruments, is a critical but rarely examined component of habitat heterogeneity
- Most previous studies are limited to relatively small spatial extents or focused only on canopy height-related metrics
- Full-waveform Lidar sensors such as Land Vegetation and Ice Sensor (LVIS) provide us a window to gauge GEDI's capability.
- The availability of GEDI data provides an opportunity to evaluate the importance of habitat vertical structure on biodiversity at broad scales.

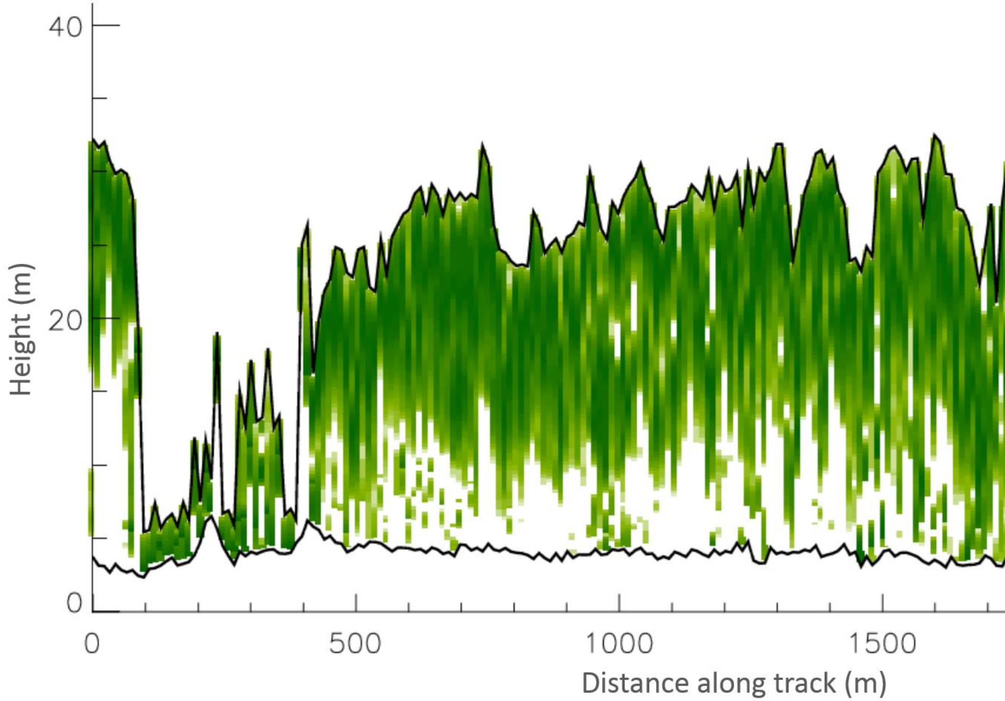
Smithsonian

- **Project Progress:**
- *1.* ***Model forest tree*** *richness using ForestGEO and NEON forest plot data .*
- *2.* ***Model avian richness*** *in the continental U.S. using North American Breeding Bird Survey data*



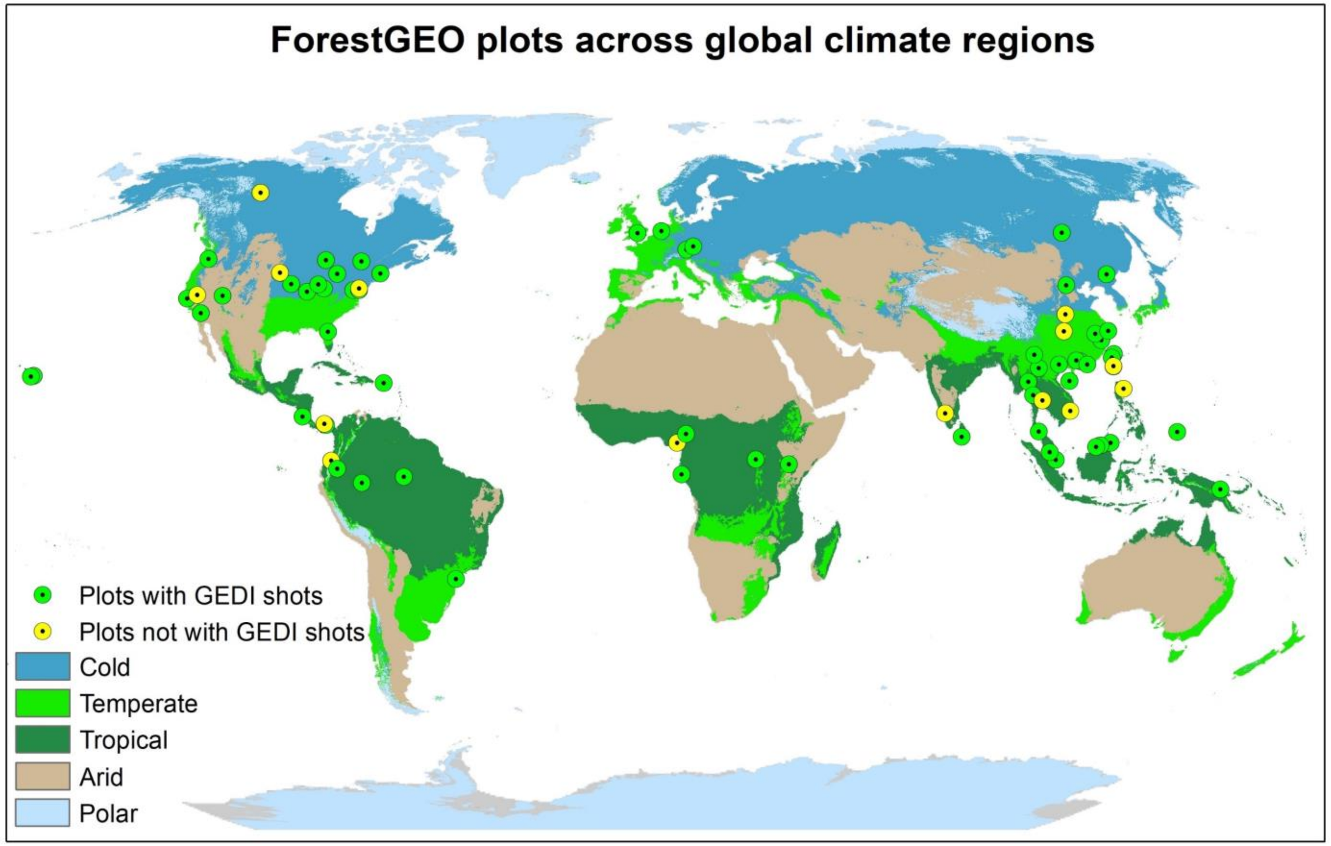


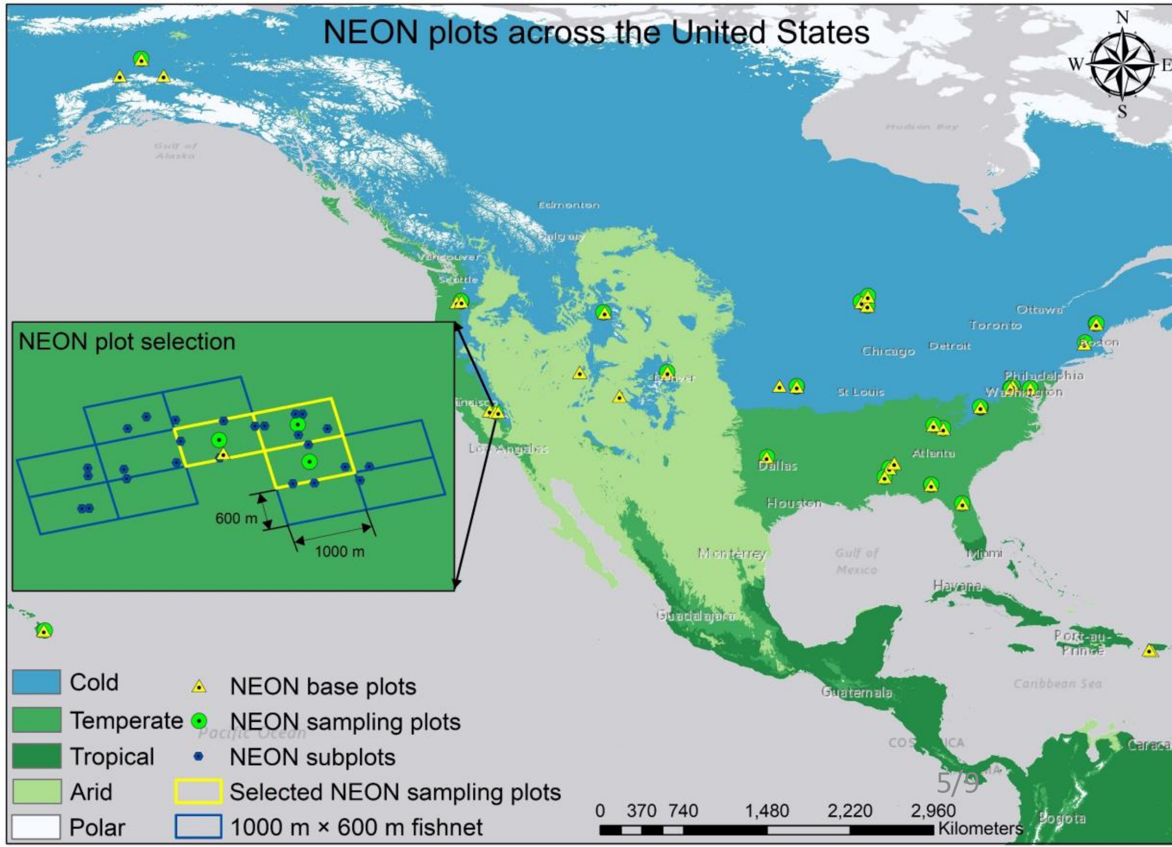
Silva at al. 2020

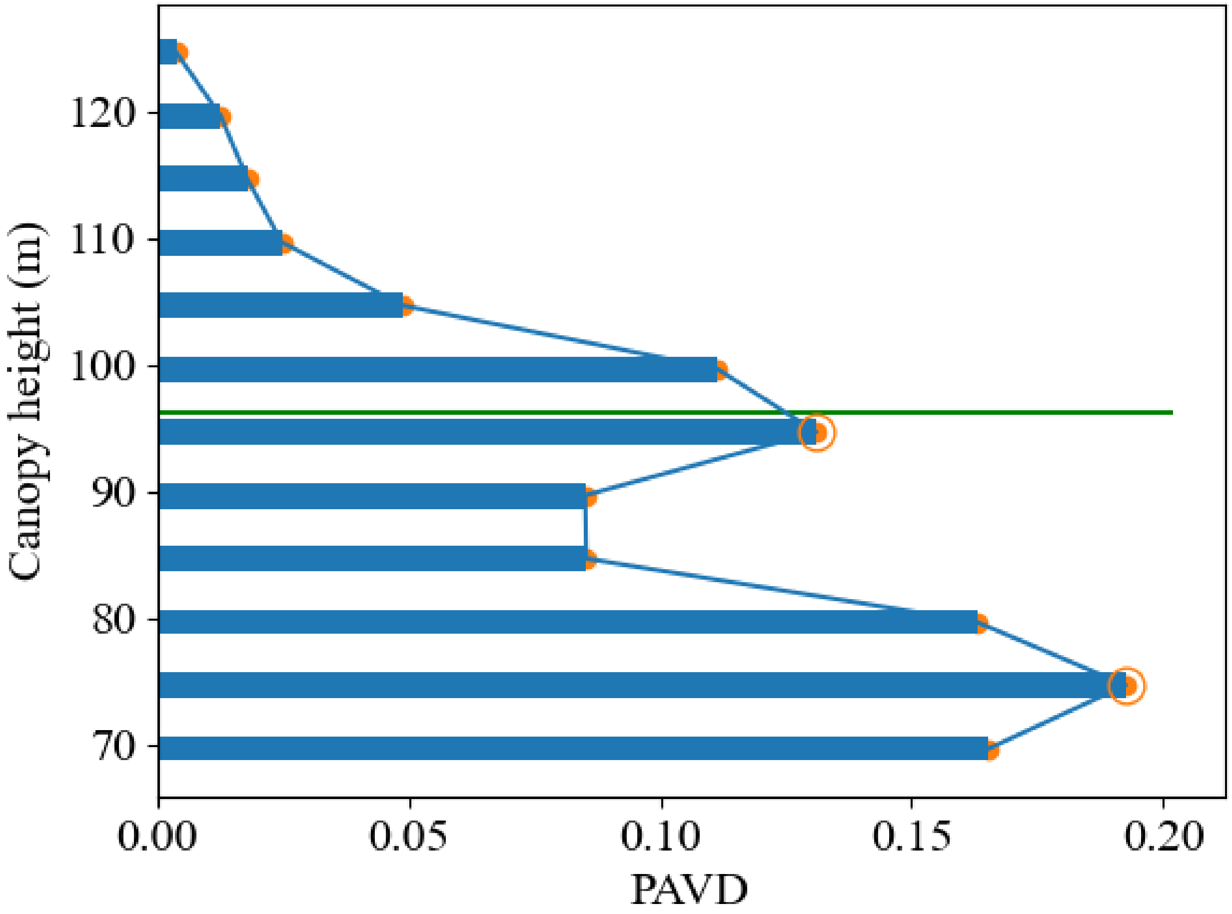


Modeling Global Forest Tree Biodiversity

- The Forest Global Earth Observatory (ForestGEO, n = 74)
- National Ecological Observatory Network (NEON, n = 51)







-Plot Size

-GEDI L2A Metrics

- Canopy Height (CH, RH98, m)

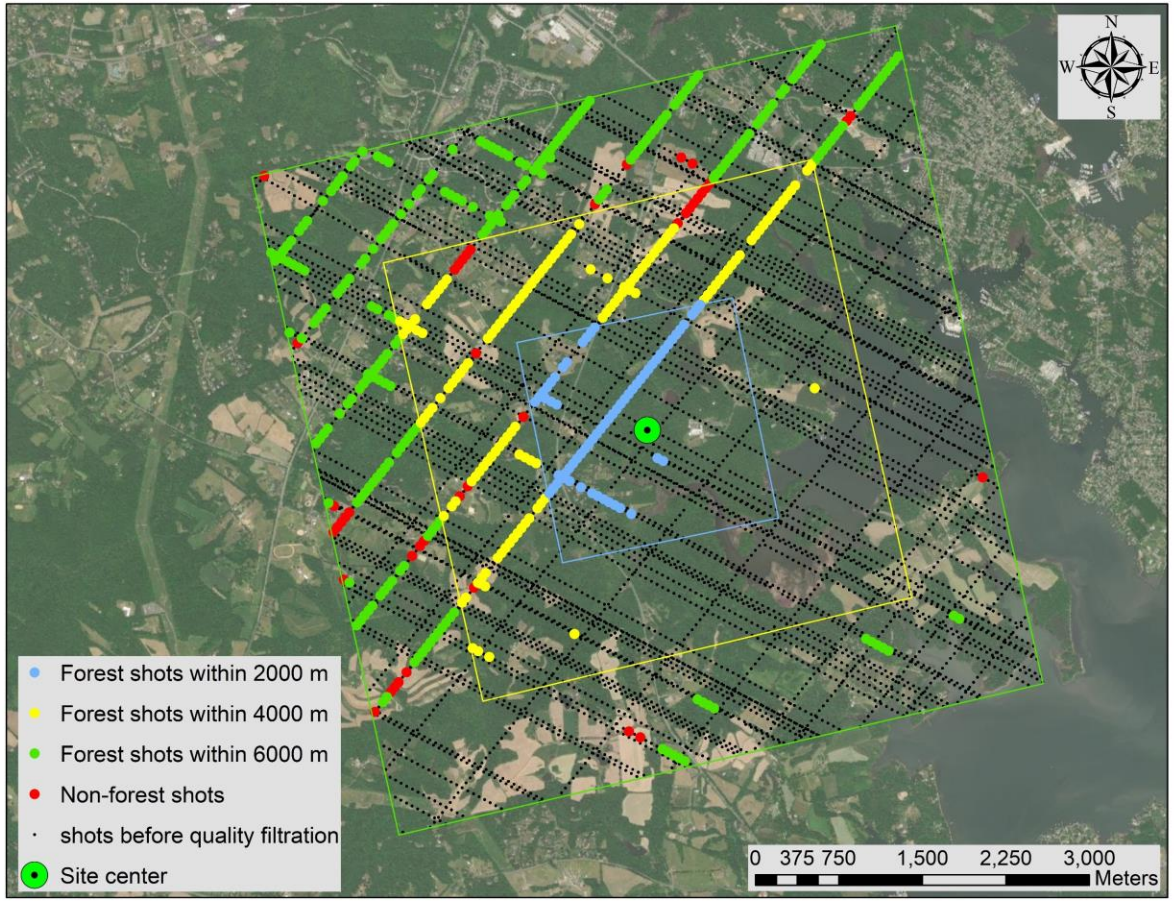
-GEDI L2B Metrics

- Plant Area Index (PAI, m2/m2)
- Foliage Height Diversity (FHD, N/A)
- Plant Area Volume Density (PAVD, m2/m3)

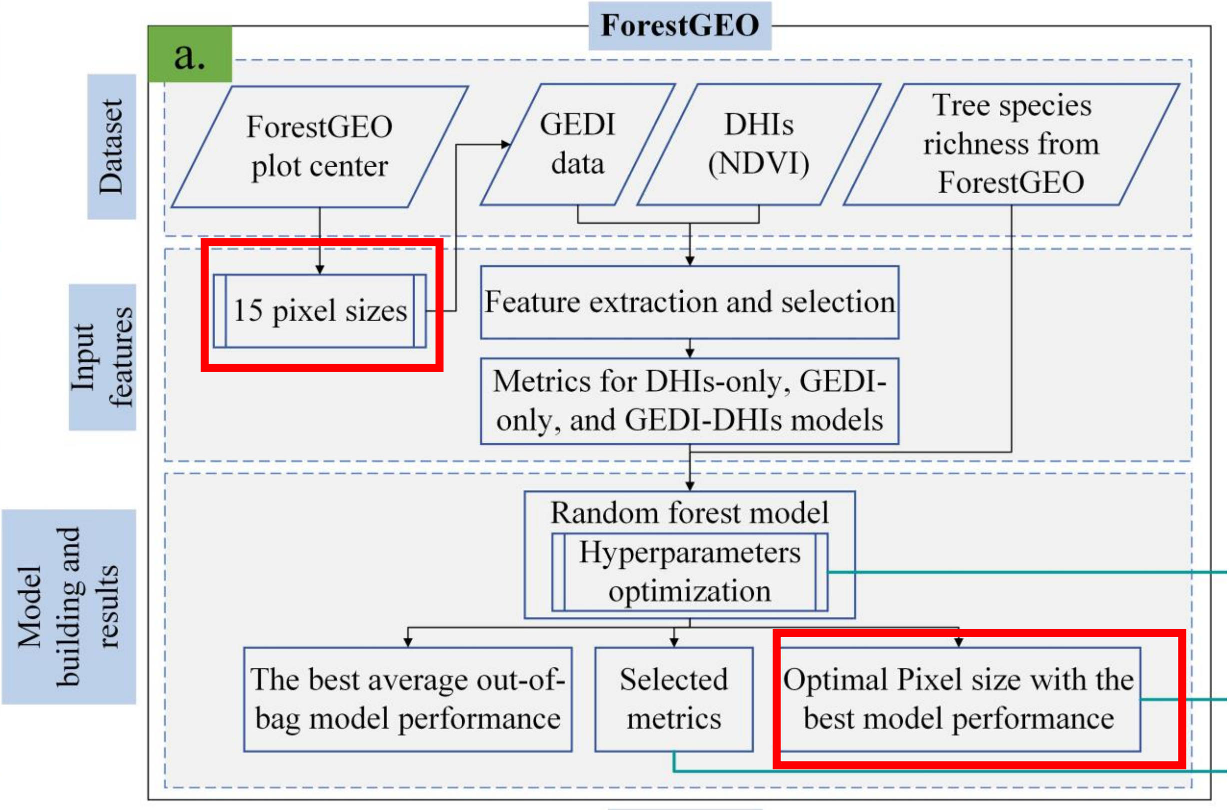
-Derivative Canopy Shape Metrics

- Number of PAVD foliage layers
    - For example (left figure): two PAVD peaks
- PAVD canopy ratio: sum of PAVD in the top strata /sum of PAVD in bottom strata
    - For example (left figure): 0.22 / 0.66 = 0.33

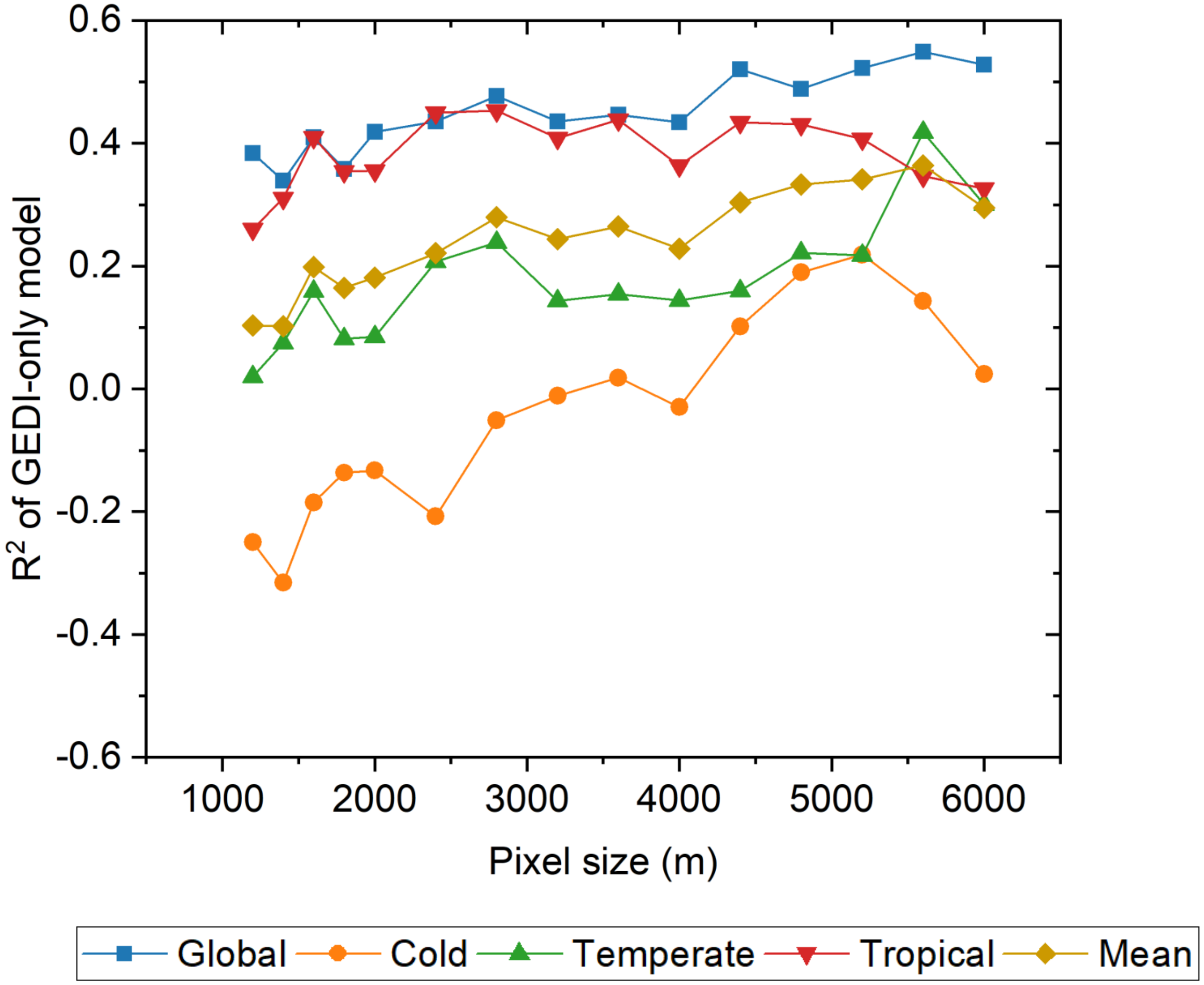
- Tested 15 buffer sizes ranging between 1200 m – 6000 m



ForestGEO plot located at Smithsonian Environmental Research Center (Edgewater, MD) with 2000 m (blue), 4000 m (yellow), and 6000 m (green) buffer sizes.

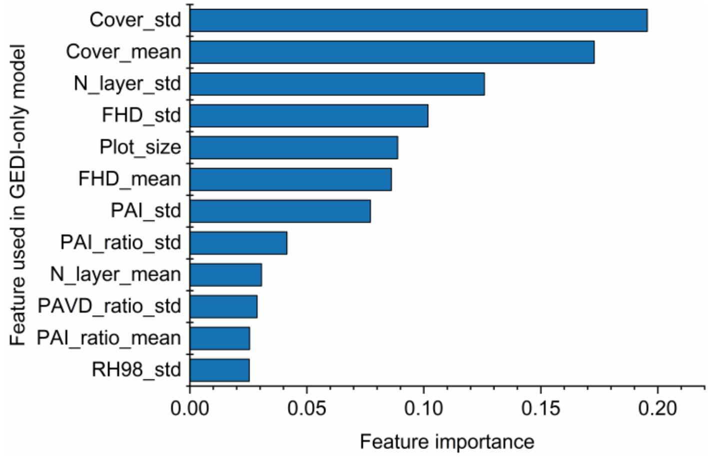


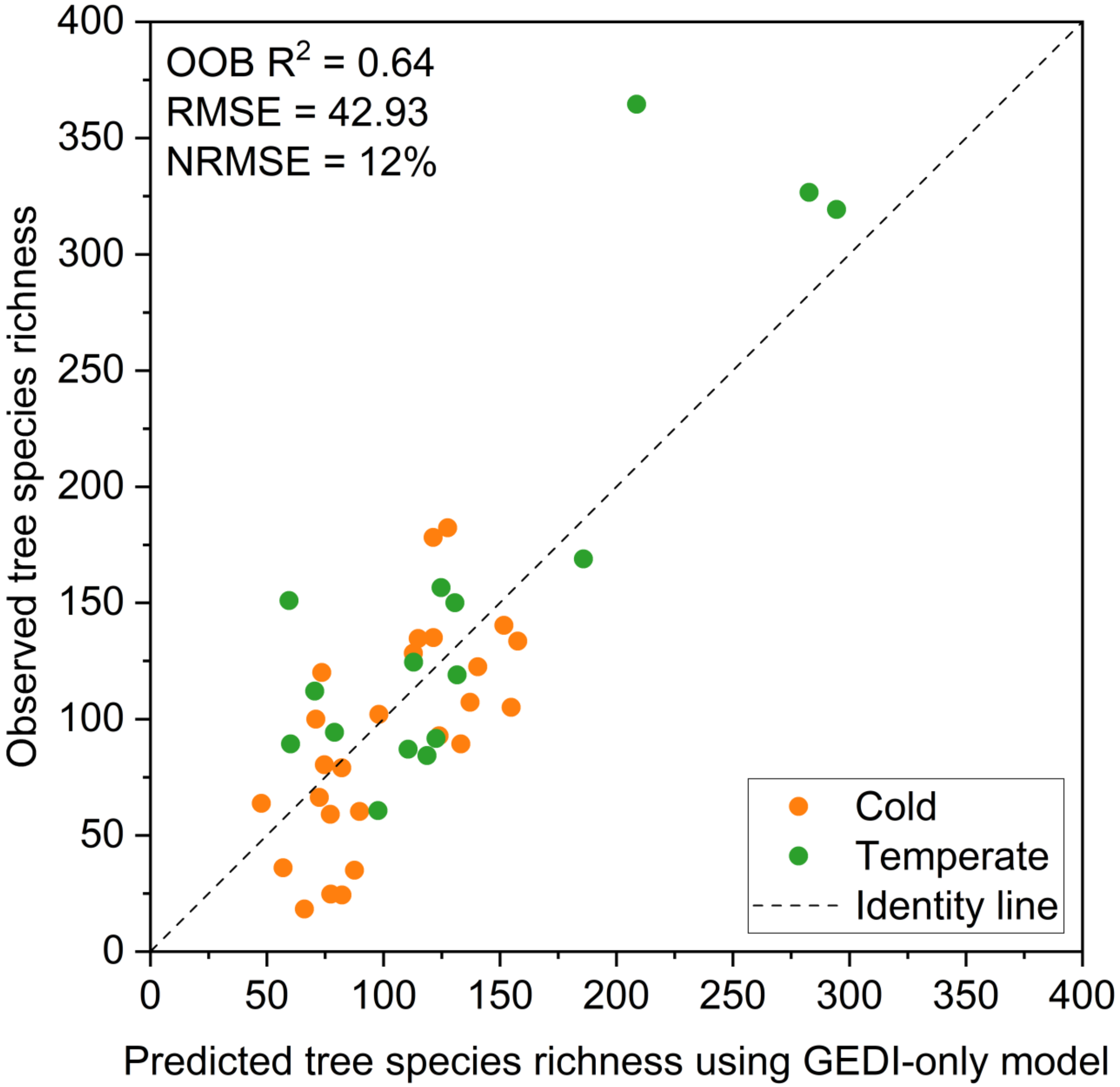
GEDI tree richness models



- Optimal buffer size at 5600m
- On average global models perform better than stratified models in individual climate zones
- Tropical climate models perform better than the rest of climate zones

NEON model performance

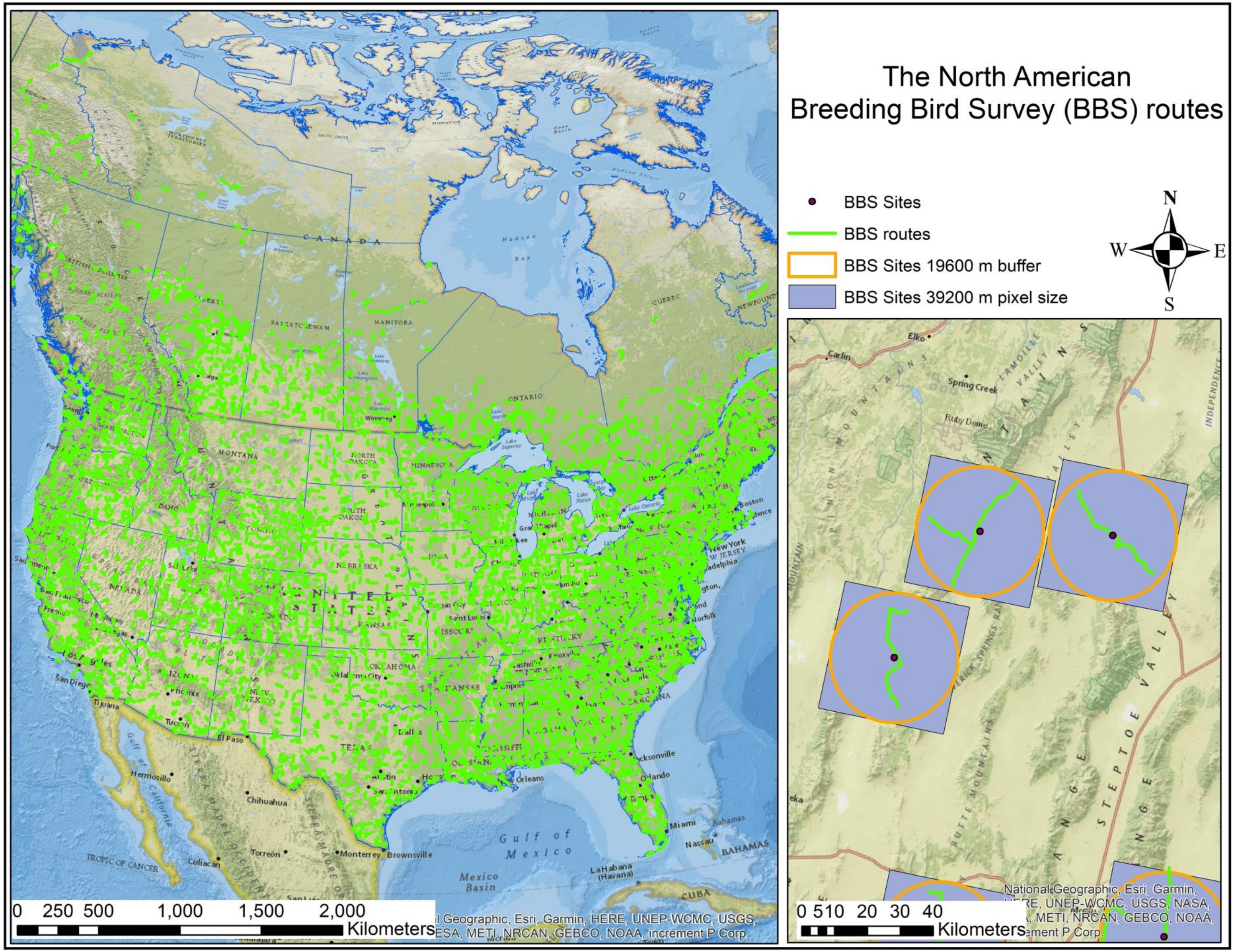


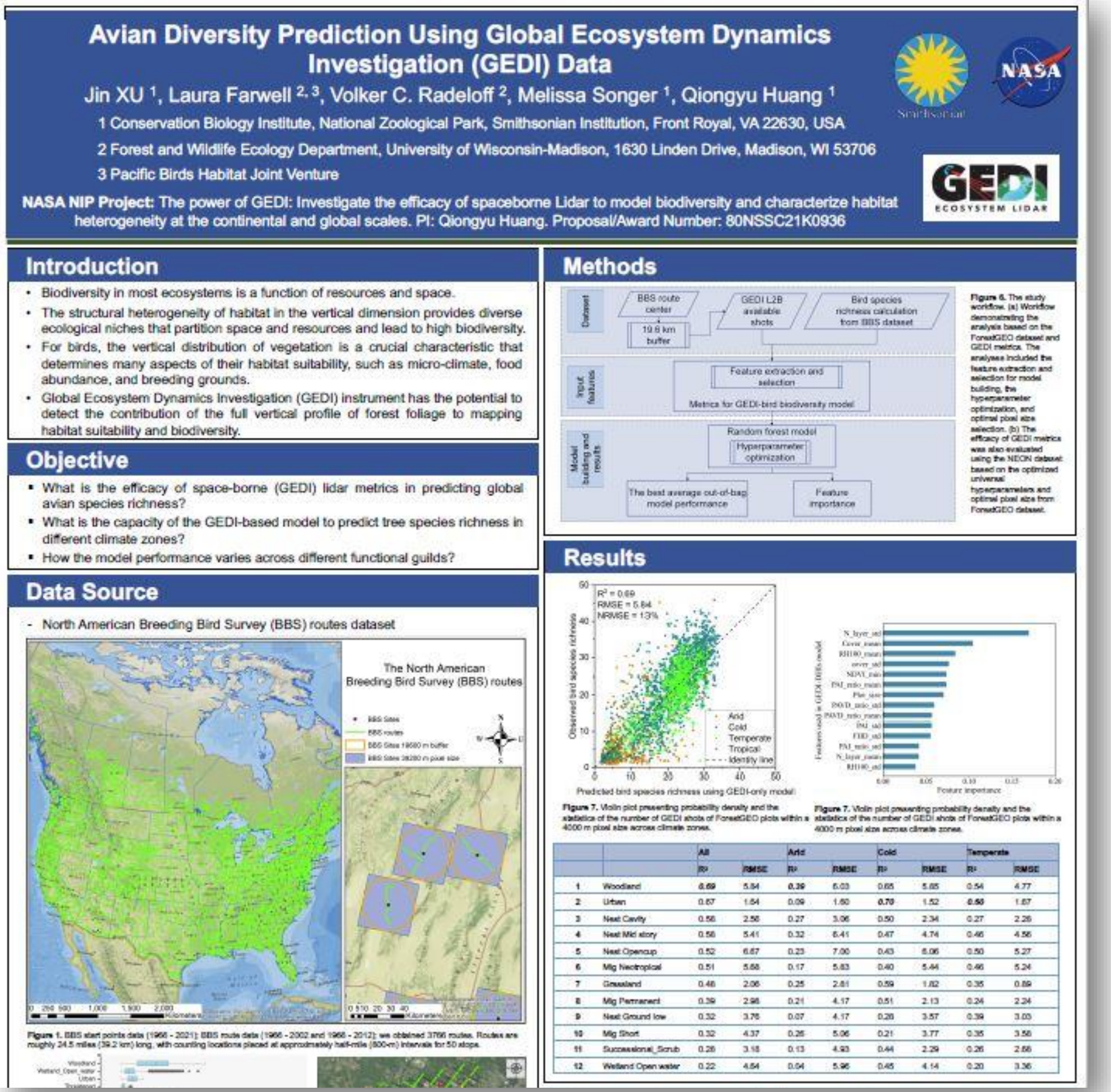


Jin Xu, Volker C. Radeloff, Melissa Songer, Kjirsten Coleman, Qiongyu Huang **Modeling Worldwide Tree Biodiversity Using Canopy Structure Metrics from Global Ecosystem Dynamics Investigation (GEDI) data** (under revision) *Ecological Applications*.

Modeling North American breeding bird richness

Avian guild by habitat , nesting , and migration types	
1	Woodland
2	Urban
3	Early succession Scrub
4	Grassland
5	Nesting Ground nesting
6	Nesting Cavity
7	Nesting Mid-story
8	Nesting Open cup
9	Permanent resident
10	Neotropical migrant
11	Short distance migrants





Dr. Jin XU's poster today 5:00-7:00 PM #1-45

Post-Doctoral Fellow
Dr. Jin Xu
Smithsonian Conservation Biology Institute

Thank You!

Smithsonian

HuangQ@si.edu

Funded by NASA Earth Science Division New (Early Career) Investigator Program (NIP) 80NSSC21K0936

NASA

GEDI ECOSYSTEM LIDAR